We claim:

1.   A method of creating a surface representation of a three-dimensional object, comprising the steps of:

a)   scanning the object with the scanner;

b)   storing scan data in a memory of a computer, the scan data comprising a cloud of
5   points, each point having three-dimensional spatial coordinates;

c)   constructing, with the computer, an initial triangle from first, second and third points, wherein the first and second points are selected from the scan data and the third point is a weighted average of a set of points in the scan data and the set of points used to construct the third point meet a predetermined criteria;

10 d)   marking the points in the set of points used to construct the third point and not using the marked points further in the modeling procedure;

e)   selecting an open edge in the initial triangle and constructing, within the computer, an adjacent triangle to said initial triangle, said adjacent triangle sharing said open edge with said initial triangle and having a vertex, wherein the vertex is constructed from a weighted
15 average of a set of points in the scan data and wherein the vertex is tested against one or more predetermined selection criteria to minimize surface deviation between the adjacent triangle and the point cloud;

f)   marking the points in the set of points used to construct the vertex and not using the marked points further in the modeling procedure; and

20 g)   successively repeating steps e) and f), to thereby construct within the computer successive adjacent triangles to open edges of previously constructed triangles using

remaining undeleted points in the scan data, and forming triangles by open edges of adjacent triangles in accordance with predefined rules for generating adjacent triangles, wherein each of the points of the adjacent triangles except for the first and second points are a weighted average of a set of points in the scan data, whereby a single, weighted average surface is generated from said initial triangle and said successive adjacent triangles.

2.   The method of claim 1, wherein the object scanned comprises a human anatomical object.

3.   The method of claim 2, wherein the object scanned comprises one or more teeth.

4.   The method of claim 1, wherein the method further comprises the steps of:

h) storing a list of triangles constructed in the computer;

i) storing a list of points of scan data;

j) marking the points used for the first point, the second point, and the set of points used to construct the third point in list of points so as to not include the points further in the modeling procedure;

k) adding the initial triangle to the list of triangles;

l) storing a list of open edges of triangles constructed by the computer;

m) updating the list of open edges as triangles are constructed by the computer; and

n) updating the list of triangles and the list of points of scan data as additional adjacent triangles are created by execution of steps e), f) and g).

5.   The method of claim 1, wherein the method further comprises the step of displaying on a monitor associated with said computer the composite, single, weighted average surface

generated from the scan data.

6.   The method of claim 1, wherein the cloud of points comprises a cumulative registration model of a series of frames, each frame comprising a set of points representing a portion of the object.

7.   The method of claim 1, wherein the weighting of said weighted average is such that those points in the scan data that contribute to the formation of a triangle whose sides are as equal as possible are assigned the greatest relative weight.

8.   A method of creating a surface representation of a three-dimensional object scanned with a scanner, comprising the steps of:

a)   scanning the object with the scanner;

b)   storing scan data in a memory of a computer, the scan data comprising a cloud of points, each point having three-dimensional spatial coordinates;

c)   constructing within the computer an initial triangle derived from points in the scan data;

d)   repeatedly constructing within the computer adjacent triangles, the adjacent triangles having at least one common edge with a previously constructed triangle, said adjacent triangles having vertices comprising either the points forming said initial triangle or points constructed from a weighted averaged of a set of points in the scan data in the region of said vertices; wherein said set of points are selected against predetermined selection criteria and wherein each new vertex is evaluated against one or more predetermined selection criteria to minimize surface deviation between an adjacent triangle and the point cloud;

15   wherein said surface representation comprises said initial triangle and said adjacent triangles.

9.   The method of claim 8, wherein the initial triangle comprises a first point, a second point, and a third point, wherein the first and second points are points in the cloud of points and wherein the third point is constructed from a weighted averaged of points in the scan data which do not exceed a maximum distance from an edge connecting said first and second points.

10.   The method of claim 8, wherein the object scanned comprises a human anatomical object.

11.   The method of claim 10, wherein the object scanned comprises one or more teeth.

12.   The method of claim 8, wherein the method further comprises the steps of:

e) storing a list of triangles constructed in the computer;

f) storing a list of points of scan data;

g) marking the points used to generate the points in the initial triangle and the vertices

5   of the successive adjacent triangles so as to not use the points further in the modeling procedure;

h) adding the initial triangle to the list of triangles;

i) storing a list of open edges of triangles constructed by the computer;

j) updating the list of open edges as triangles are constructed by the computer; and

10   k) updating the list of triangles and the list of points of scan data as additional adjacent triangles are created by execution of step d).

13.   The method of claim 8, wherein the method further comprises the step of displaying on a monitor associated with said computer the surface representation.

14.   The method of claim 8, wherein the cloud of points comprises a cumulative registration model comprising a set of frames registered to each other, each frame comprising a set of points representing a portion of the object.

15.   The method of claim 8, wherein the weighting of said weighted average is such that those points in the scan data that contribute to the formation of a triangle whose sides are as equal as possible are assigned the greatest relative weight.

16.   A method of creating a surface representation of a three-dimensional object from a cloud of points, each point having three-dimensional spatial coordinates, comprising the steps of:

a)   storing the cloud of points in a memory of a computer;

5   b)   storing, in the memory of the computer, a list of points comprising the cloud of points;

d)   storing, in the memory of the computer, a list of open edges, said open edges comprising a line segment joining two points in which the line segment is not a common edge of two adjacent triangle constructed from the cloud of points; and

e)   providing machine executable instructions for said computer that operate on said

10 cloud of points, said instructions:

        1)   constructing an initial open edge from points in the cloud of points;

2)   constructing a triangle forming a portion of said surface representation from the open edge using predetermined rules for generating triangles forming said surface representation;

3)   adjusting the list of open edges in view of the construction of said triangle;

4)   checking to see if the are open edges that not been tried yet to form a triangle forming a portion of said surface representation, and if so repeating steps 2) and 3);

5)   as steps 2), 3) and 4) execute, adjusting the list of points by deleting points in the list of points that are used to generate vertices of triangles in step 2); and

6)   repeatedly iterating steps 2), 3), 4) and 5) until all open edges have been attempted to generate triangles in accordance with said predetermined rules for generating triangles and all remaining points in the list of points have been attempted to generate a vertex of a new triangle in accordance within predetermine rules for generating vertices of triangles forming said surface.

17.   The method of claim 16, wherein the cloud of points are obtained from a scan of a three-dimensional object with a scanner.

18.   The method of claim16, wherein the cloud of points comprises a cumulative registration model comprising a set of frames registered to each other, each frame comprising a set of points representing a portion of the object.

19.   A method of creating a surface representation of a three-dimensional object from a cloud of points, each point having three-dimensional spatial coordinates, comprising the steps of:

a)   storing the cloud of points in a memory of a computer;

b) providing machine executable instructions for said computer that operate on said cloud of points, said instructions constructing an initial triangle and a multitude of adjacent triangles forming a single continuous surface representing said object, said triangles comprising planar surfaces having three vertices, wherein said vertices comprise points forming said initial triangle and points computed as a weighted average of nearby points in said cloud of points.

20. A method for constructing a three-dimensional model of an anatomical structure, comprising the steps of:

scanning the anatomical structure with a scanner and obtaining scan data;

converting the scan data to a cloud of points;

storing the cloud of points in a memory of a computer; and

executing machine executable instructions in said computer, said instructions that operating on said cloud of points to construct an initial triangle and a multitude of adjacent triangles forming a single continuous surface representing said object, said triangles comprising planar surfaces having three vertices, wherein said vertices comprise points forming said initial triangle and points computed as a weighted average of nearby points in said cloud of points, and wherein said vertices are tested against one or more predetermined selection criteria to minimize surface deviation between the adjacent triangle and the point cloud.

21. The method of claim 20, wherein said anatomical structure comprises teeth.

22.   The method of claim 21, wherein said scanner comprises a hand-held three-dimensional scanner.

23.   The method of claim 21, wherein said scanner comprises a laser scanner and said anatomical structure comprises a model of teeth.